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3-03199-TA

CONTROLLER OF POWER MOSFET FOR SYNCHRONOUS RECTIFICATION

Patent number: JP7007928
Publication date: 1995-01-10

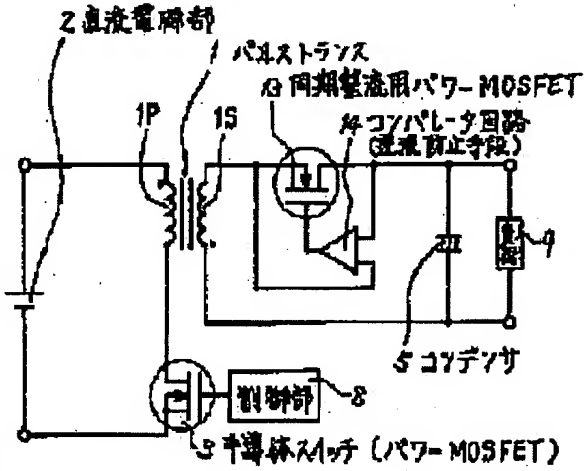
Inventor: FUJISAWA NAOTO
Applicant: FUJI ELECTRIC CO LTD

Classification:
- international: H02M3/28; H02M7/06
- european:
Application number: JP19930142414
Priority number(s):

Abstract of **JP7007928**

PURPOSE:To reduce the load of a transformer and to reduce a drop in a forward voltage by suppressing the flow of the backward current of a power MOSFET for synchronous rectification.

CONSTITUTION:The controller of a power MOSFET 13 for synchronous rectification is connected to the side of a secondary winding 1S for a pulse transformer 1 in a switching power-supply apparatus which uses a flyback converter circuit, a forward converter circuit or the like as a fundamental circuit, and it rectifies an output current. Thereby, for example, comparator circuit 14 is provided as a backward-current prevention means wherein a change in the direction of a current flowing across a source and a drain for the power MOSFET 13, for synchronous rectification, which can control a forward current and a backward current by a gate driving signal is monitored and a driving signal which is supplied to a gate for the power MOSFET for synchronous rectification is stopped while the backward current flows.



(19)日本国特許庁（ＪＰ）　(12)特　許　公　報（Ｂ２）　(11)特許番号

特許第3152016号
(P3152016)

(45)発行日　平成13年４月３日(2001.4.3)　(24)登録日　平成13年１月26日(2001.1.26)

(51)Int.Cl.[7]	識別記号	ＦＩ	
Ｈ０２Ｍ　3/28		Ｈ０２Ｍ　3/28	Ｆ
7/06		7/06	Ｈ

請求項の数１(全　5　頁)

(21)出願番号　特願平5－142414

(22)出願日　平成５年６月15日(1993.6.15)

(65)公開番号　特開平7－7928

(43)公開日　平成７年１月10日(1995.1.10)

審査請求日　平成10年８月19日(1998.8.19)

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特開　平３－218264（ＪＰ，Ａ）
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実開　平６－44396（ＪＰ，Ｕ）
実開　平４－58087（ＪＰ，Ｕ）

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(54)【発明の名称】　同期整流用パワーＭＯＳＦＥＴの制御装置

(57)【特許請求の範囲】

【請求項１】フライバックコンバータ回路，フォワードコンバータ回路等を基本回路とするスイッチング電源装置のパルストランスの二次巻線側に接続されて出力電流を整流する同期整流用パワーＭＯＳＦＥＴの制御装置であって、ゲート駆動信号により順方向電流および逆方向電流の制御が可能な前記同期整流用パワーＭＯＳＦＥＴのソース・ドレイン間に流れる電流の方向の変化を監視し、逆方向電流が流れる期間同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止する逆流防止手段を備え、前記逆流防止手段が前記二次巻線側の回路に流れる電流の検出器、およびその出力側に接続された抵抗器と、この抵抗器の両端の電位の変化を監視するコンパレータ回路とからなり、この抵抗器の両端の電位の変化から同期整流用パワーＭＯＳＦＥＴに流れる電流の方向が順方向電流から逆方向電流に変化すると判定されたとき、コンパレータ回路が同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止するよう形成してなることを特徴とする同期整流用パワーＭＯＳＦＥＴの制御装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、直流出力電圧が数ボルトと低いスイッチング電源装置などの出力電流を整流するために用いられる同期整流用パワーＭＯＳＦＥＴの制御装置に関する。

【０００２】

【従来の技術】図７は従来のスイッチング電源装置の基本回路の一例としてのフライバックコンバータを簡略化して示す接続図であり、パルストランス１の一次巻線１

Ｐには例えば整流ブリッジなどの直流電源２および半導体スイッチとしてのパワーＭＯＳＦＥＴ３が接続される。また、パルストランス１の二次巻線１Ｓにはショットキバリアダイオードなどの高速整流ダイオード４および平滑用のコンデンサ５が接続され、パルストランス１の巻線の極性を図の・印のように選び、半導体スイッチ２をその制御部８によりオンオフ制御することにより、コンデンサ５に並列に接続された負荷９に直流電力が供給される。即ち、半導体スイッチ３がオンのとき、二次側出力は高速整流ダイオード４によってブロックされ、負荷９にはコンデンサ５の蓄積電荷が放出される。また、半導体スイッチ３がオフするとき一次巻線１Ｐに生ずる逆起電力が二次巻線１Ｓ側に伝達され、高速整流ダイオード４で整流され、コンデンサ５で平滑化した直流電圧に変換され、負荷９に直流電力として供給される。

【０００３】

【発明が解決しようとする課題】ところで、直流出力電圧が３．３Ｖ程度のスイッチング電源装置の場合、高速整流ダイオード４の順方向電圧降下が０．５Ｖ程度と直流出力電圧に占める割合が高く、これが原因で高い電力変換効率が得られないという問題がある。一方、スイッチング電源装置に半導体スイッチ３として用いられるパワーＭＯＳＦＥＴはスイッチングロスが少なくオン抵抗も低いので、これを同期整流用パワーＭＯＳＦＥＴとして高速整流ダイオード４と置き換えることにより、順方向電圧降下を大幅に低減して変換効率を高めることができると期待される。しかしながら、パワーＭＯＳＦＥＴには双方向に電流が流れる性質があるため、二次巻線１Ｓ側の電位が負荷側の電位より低くなった場合には、負荷側（コンデンサ側）からトランス側に電流が逆流し、この逆流電力によってトランスの負荷が増加するためにトランス１が大型化するという問題が発生する。

【０００４】また、パワーＭＯＳＦＥＴには双方向に電流が流れる性質を積極的に利用したフライバックコンバータ方式の回生制御装置も知られているが、この方式では電力の回生によってトランスの負荷が増加し、これが原因でトランスが大型化することを回避できないという問題があるため、高周波数化による小型化が重要視される直流出力電圧が３．３Ｖ程度のスイッチング電源装置においては、パワーＭＯＳＦＥＴの電流の逆流を阻止して同期整流用パワーＭＯＳＦＥＴとして利用し、電力変換効率を向上し，トランスを小型化する方向の技術開発が求められている。

【０００５】この発明の目的は、同期整流用パワーＭＯＳＦＥＴの逆方向電流の通流を阻止してトランスの負荷を軽減し、かつ順方向電圧降下を低減することにある。

【０００６】

【課題を解決するための手段】上記課題を解決するために、この発明によれば、フライバックコンバータ回路，フォワードコンバータ回路等を基本回路とするスイッチング電源装置のパルストランスの二次巻線側に接続されて出力電流を整流する同期整流用パワーＭＯＳＦＥＴの制御装置であって、ゲート駆動信号により順方向電流および逆方向電流の制御が可能な前記同期整流用パワーＭＯＳＦＥＴのソース・ドレイン間に流れる電流の方向の変化を監視し、逆方向電流が流れる期間同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止する逆流防止手段を備え、逆流防止手段が前記二次巻線側の回路に流れる電流の検出器、およびその出力側に接続された抵抗器と、この抵抗器の両端の電位の変化を監視するコンパレータ回路とからなり、この抵抗器の両端の電位の変化から同期整流用パワーＭＯＳＦＥＴに流れる電流の方向が順方向電流から逆方向電流に変化すると判定されたとき、コンパレータ回路が同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止するよう形成してなるものとする。

【０００７】

【作用】この発明において、同期整流用パワーＭＯＳＦＥＴに流れる電流の方向の変化を監視し、逆方向電流が流れる期間同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止する逆流防止手段を設けるよう構成したことにより、ゲート電圧により順方向および逆方向の電流を制御できるパワーＭＯＳＦＥＴの特性と、この電流の方向の変化を監視し、逆方向電流が流れる期間同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止する逆流防止手段との組み合わせにより、同期整流用パワーＭＯＳＦＥＴの逆方向電流の通流を阻止できるので、パワーＭＯＳＦＥＴを半導体スイッチのオンオフ動作に同期して出力電流を整流するオン抵抗の低い整流素子として機能させることが可能となり、直流出力電圧が3.3 ボルト程度のスイッチング電源装置に適用した場合、パワーＭＯＳＦＥＴの低いオン抵抗を利用して電力変換効率を向上する機能が得られるとともに、トランス側への電力の逆流を阻止してトランスの負荷を軽減し、パルストランスを小型化する機能が得られる。

【０００８】更に、逆流防止手段を同期整流用パワーＭＯＳＦＥＴを有するパルストランスの二次巻線側回路に流れる電流の検出器、およびその出力側に接続された抵抗器と、この抵抗器の両端の電位の変化を監視するコンパレータ回路とで構成し、この抵抗器の両端の電位の変化から同期整流用パワーＭＯＳＦＥＴに流れる電流の方向が順方向電流から逆方向電流に変化すると判定されたとき、コンパレータ回路が同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止するよう構成すれば、抵抗器を電流検出器としての変流器の出力側に設けて損失を低減できるので、構成部材の数は増えるものの、発明の目的を達成する機能が得られる。

【０００９】

【実施例】以下、この発明を実施例に基づいて説明する。図１はこの発明の参考例になる同期整流用パワーＭ

ＯＳＦＥＴを用いたフライバックコンバータ方式のスイッチング電源装置を簡略化して示す接続図であり、従来技術と同じ構成部分には同一参照符号を付すことにより、重複した説明を省略する。図において、パルストランス１の一次巻線１Ｐには例えば整流ブリッジなどの直流電源２および半導体スイッチとしてのパワーＭＯＳＦＥＴ３が従来と同様に接続される。また、パルストランス１の二次巻線１Ｓには出力電流の整流素子として同期整流用パワーＭＯＳＦＥＴ１３および平滑用のコンデンサ５が接続され、パルストランス１の巻線の極性を図の・印のように減極性に選び、かつ順逆両方向に通流性を有する同期整流用パワーＭＯＳＦＥＴ１３のソース側を二次巻線１Ｓに，ドレイン側を負荷９側に接続する。また、同期整流用パワーＭＯＳＦＥＴ１３のゲート電圧を制御する逆流防止手段はコンパレータ回路１４からなり、ソース電位がドレイン電位と同等またはそれ以下に低下したとき同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止するよう構成される。

【００１０】上述のように構成したフライバックコンバータ形スイッチング電源装置において、半導体スイッチ３がオンしたとき、トランス１の２次巻線側には同期整流用パワーＭＯＳＦＥＴ１３をそのドレイン側からソース側に向けて逆方向電流を流す方向に起電力が発生する。しかしこの時、同期整流用パワーＭＯＳＦＥＴ両端の電位はドレイン側で高くソース側で低くなるので、これを監視するコンパレータ回路１４がその出力ゲート電圧の出力を停止する。このため、ゲート電圧により順逆両方向の電流の制御が可能なパワーＭＯＳＦＥＴ１３はオフ状態となり、出力電流が２次巻線に逆流することによって従来生じたパルストランス１の負荷の増加が阻止され、トランス１を小型化することが可能になるとともに、負荷９への直流電力の供給は平滑コンデンサ５の蓄積電荷を放出することによって行われる。

【００１１】また、半導体スイッチ３がオフするとき一次巻線１Ｐに生ずる逆起電力が二次巻線１Ｓ側に伝達され、これにより同期整流用パワーＭＯＳＦＥＴ１３の両端電位はソース側で高く，ドレイン側で低くなるので、これを感知したコンパレータ回路１４が順方向電流の通流を促すゲート電圧を出力し、同期整流用パワーＭＯＳＦＥＴ１３で整流され，コンデンサ５で平滑化した直流電力が負荷９に供給される。その結果、オン抵抗がショットキーバリアダイオードなどの整流素子に比べて低く低損失なパワーＭＯＳＦＥＴの特性を利用することが可能となり、スイッチング電源装置の電力変換効率を向上できる利点が得られる。

【００１２】図２は上述の参考例の変形例を示す接続図であり、同期整流用パワーＭＯＳＦＥＴ１３を二次巻線１Ｓの他方の端子側に移し、そのソース側を巻線に接続した点が前述の参考例と異なっているが、このように構成しても前述の参考例と同様な作用効果を得ることができる。また、図示しないが、同期整流用パワーＭＯＳＦＥＴ１３をそのドレインからソースに向かう電流を順方向電流としてパルストランスの二次巻線に接続した場合においても、ソース電位がドレイン電位と同等またはそれ以下に低下したとき同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止するよう、コンパレータ回路１４を同期整流用パワーＭＯＳＦＥＴ１３に接続することにより、前述の参考例におけると同様の作用効果が得られる。

【００１３】図３はこの発明の異なる参考例になる同期整流用パワーＭＯＳＦＥＴの制御装置を用いたフライバックコンバータ形スイッチング電源装置を簡略化して示す接続図、図４は図３に示す異なる参考例の変形例を簡略化して示す接続図であり、逆流防止手段２１を、同期整流用パワーＭＯＳＦＥＴ１３を有するパルストランスの二次巻線側回路に直列接続された抵抗器２５と、この抵抗器の両端の電位の変化を監視するコンパレータ回路２４とで構成した点が前述の実施例と異なっており、同期整流用パワーＭＯＳＦＥＴ１３のソース電位およびドレイン電位を、抵抗器２５の両端の電位に置き換えて検出することにより、前述の参考例と同様の作用効果が得られる。なお、抵抗器２５は図４に示す位置に接続してもよく、その接続位置を任意に選択することができる。

【００１４】図５はこの発明の実施例になる同期整流用パワーＭＯＳＦＥＴの制御装置を用いたフライバックコンバータ形スイッチング電源装置を簡略化して示す接続図であり、逆流防止手段３１を同期整流用パワーＭＯＳＦＥＴ１３を有するパルストランス１の二次巻線側回路に流れる電流の検出器３３、およびその出力側に接続された抵抗器３５と、この抵抗器の両端の電位の変化を監視するコンパレータ回路３４とで構成し、抵抗器３５の両端の電位の変化から同期整流用パワーＭＯＳＦＥＴ１３に流れる電流の方向が順方向電流から逆方向電流に変化すると判定されたとき、コンパレータ回路３４が同期整流用パワーＭＯＳＦＥＴ１３のゲートに供給する駆動信号を停止するよう構成される。抵抗器を電流検出器３３としての変流器の出力側に設けることによりその損失を低減できるので、構成部材の数は増えるものの、前述の各参考例と同様の作用効果が得られる。

【００１５】図６はこの発明の参考例になる同期整流用パワーＭＯＳＦＥＴの制御装置を用いたフォワードコンバータ方式のスイッチング電源装置を簡略化して示す接続図であり、パルストランス１１は図示しない直流偏磁防止用の三次巻線を備え、その一次巻線１１Ｐと二次巻線１１Ｓの極性は図に・印で示すように加極性となるよう接続される。また、二次巻線１Ｓ側には出力電流の整流素子として同期整流用パワーＭＯＳＦＥＴ１３，平滑用のコンデンサ５，リアクトル７，および還流ダイオード６が接続され、ソースからドレインに向かう電流を順方向電流として、ソース側を二次巻線１１Ｓに，ドレイ

ン側をリアクトル７を介して負荷９側に接続する。また、同期整流用パワーＭＯＳＦＥＴ１３のゲート電圧を制御する逆流防止手段は図１について説明したと同様にコンパレータ回路１４からなり、ソース電位がドレイン電位と同等またはそれ以下に低下したとき同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止するよう構成される。

【００１６】このように構成されたフォワードコンバータ方式のスイッチング電源装置においては、半導体スイッチ３がオンするとき同期整流用パワーＭＯＳＦＥＴ１３には順方向電流が流れ、半導体スイッチ３がオフするとき、同期整流用パワーＭＯＳＦＥＴ１３のソース電位がドレイン電位に比べて低くなり、これを検知したコンパレータ回路１４がゲートへの駆動電圧の出力を停止するので、パワーＭＯＳＦＥＴが同期整流用パワーＭＯＳＦＥＴとして機能し、トランス側への逆流電力を阻止してトランスの負荷を軽減するとともに、パワーＭＯＳＦＥＴの低いオン抵抗を利用してスイッチング電源装置の電力変換効率を向上する効果が得られる。

【００１７】

【発明の効果】この発明は前述のように、同期整流用パワーＭＯＳＦＥＴに流れる電流の方向の変化を監視し、逆方向電流が流れる期間同期整流用パワーＭＯＳＦＥＴのゲートに供給する駆動信号を停止する逆流防止手段を設けるよう構成した。その結果、パワーＭＯＳＦＥＴを半導体スイッチのオンオフ動作に同期して出力電流を整流するオン抵抗の低い整流素子として利用することが可能となり、直流出力電圧が3.3 ボルト程度のスイッチング電源装置に適用した場合、パワーＭＯＳＦＥＴの低いオン抵抗を利用して電力変換効率を向上する機能が得られるとともに、トランス側への電力の逆流を阻止してトランスの負荷を軽減し、パルストランスを小型化できる利点が得られる。

【図面の簡単な説明】

【図１】この発明の参考例になる同期整流用パワーＭＯＳＦＥＴを用いたフライバックコンバータ形スイッチング電源装置を簡略化して示す接続図

【図２】図１に示す参考例の変形例を示す接続図

【図３】この発明の異なる参考例になる同期整流用パワーＭＯＳＦＥＴの制御装置を用いたフライバックコンバータ形スイッチング電源装置を簡略化して示す接続図

【図４】図３に示す異なる参考例の変形例を簡略化して示す接続図

【図５】この発明の実施例になる同期整流用パワーＭＯＳＦＥＴの制御装置を用いたフライバックコンバータ形スイッチング電源装置を簡略化して示す接続図

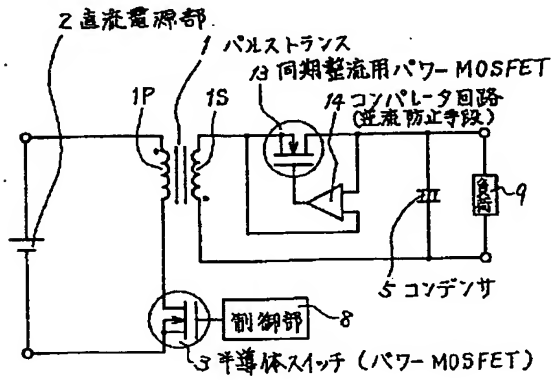
【図６】この発明の参考例になる同期整流用パワーＭＯＳＦＥＴの制御装置を用いたフォワードコンバータ方式のスイッチング電源装置を簡略化して示す接続図

【図７】従来のスイッチング電源装置の基本回路の一例としてのフライバックコンバータを簡略化して示す接続図

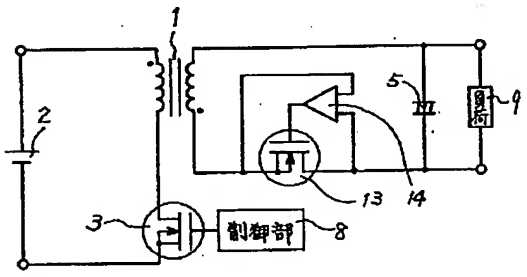
【符号の説明】

１　パルストランス
２　直流電源部
３　半導体スイッチ（パワーＭＯＳＦＥＴ）
４　高速整流ダイオード
５　コンデンサ
６　帰還ダイオード
７　リアクトル
８　制御部
９　負荷
１１　パルストランス
１３　同期整流用パワーＭＯＳＦＥＴ
１４　コンパレータ回路（逆流防止手段）
２１　逆流防止手段
２４　コンパレータ回路
２５　抵抗器
３１　逆流防止手段
３３　電流検出器
３４　コンパレータ回路
３５　抵抗器

【図１】



【図２】



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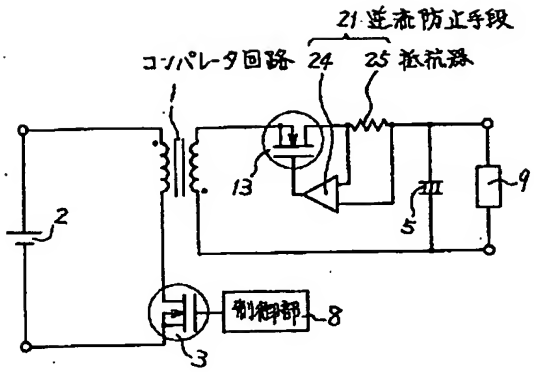

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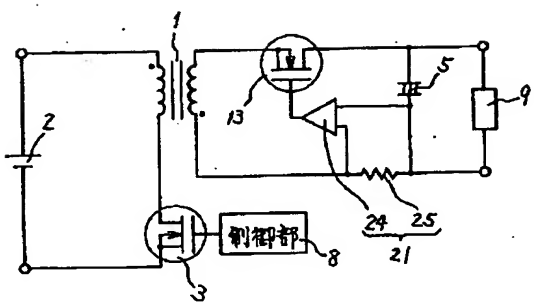

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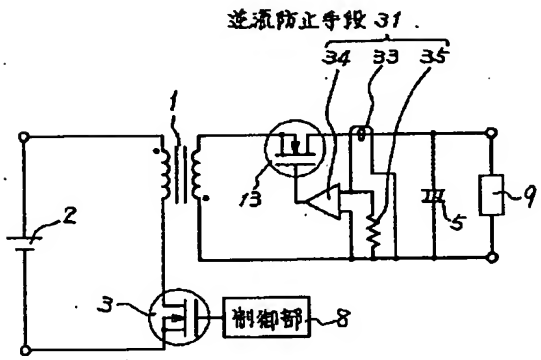

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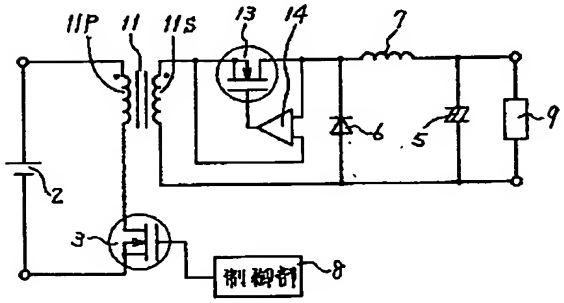
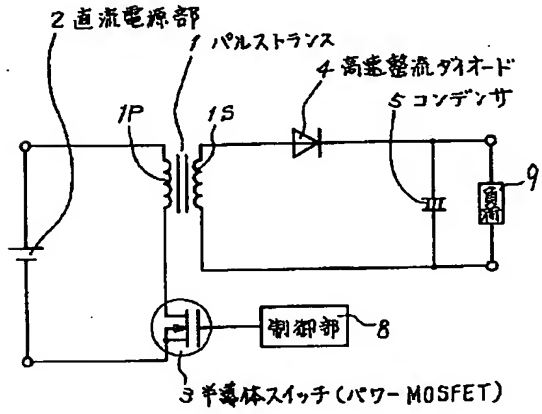


【図７】



フロントページの続き

(58) 調査した分野 (Int. Cl. 7, ＤＢ名)

H02M　3/28

H02M　7/06

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CLAIMS

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(57) [Claim(s)]
[Claim 1] It is the control unit of the power metal-oxide semiconductor field effect transistor for synchronous detection which is connected to the secondary-winding side of the pulse transformer of the switching power supply equipment which makes a basic circuit a flyback converter circuit, a forward converter circuit, etc., and rectifies the output current. Change of the direction of the current which flows with a gate driving signal between the source drains of said power metal-oxide semiconductor field effect transistor for synchronous detection which can control forward current and a reverse current is supervised. It has an antisuckback means to stop the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for period synchronous detection where a reverse current flows. The detector of a current with which said antisuckback means flows in the circuit by the side of said secondary winding, and the resistor connected to the output side, When it judges that the direction of the current which consists of a comparator circuit which supervises change of the potential of the both ends of this resistor, and flows from change of the potential of the both ends of this resistor to the power metal-oxide semiconductor field effect transistor for synchronous detection changes from forward current to a reverse current, The control unit of the power metal-oxide semiconductor field effect transistor for synchronous detection characterized by forming and becoming so that the driving signal which a comparator circuit supplies to the gate of the power metal-oxide semiconductor field effect transistor for synchronous detection may be stopped.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the control unit of the power metal-oxide semiconductor field effect transistor for synchronous detection used since direct-current output voltage rectifies the output current of several volts, low switching power supply equipment, etc.
[0002]
[Description of the Prior Art] Drawing 7 is the connection diagram simplifying and showing the flyback converter as an example of the basic circuit of conventional switching power supply equipment, and the power metal-oxide semiconductor field effect transistor 3 as DC power supply 2 and solid state switches, such as a rectification bridge, is connected to primary-winding 1P of a pulse transformer 1. Moreover, direct current power is supplied to the load 9 connected to the capacitor 5 at juxtaposition by connecting the high-speed rectifier diodes 4, such as a schottky-barrier diode, and the capacitor 5 for smooth to secondary-winding 1S of a pulse transformer 1, choosing the polarity of the coil of a pulse transformer 1 like - mark of drawing, and carrying out on-off control of the solid state switch 2 by the control section 8. That is, when a solid state switch 3 is ON, a secondary output is blocked with the high-speed rectifier diode 4, and the stored charge of a capacitor 5 is emitted to a load 9. Moreover, when a solid state switch 3 turns off, it is transmitted to the secondary-winding 1S side, and is rectified by the high-speed rectifier diode 4, and back EMF produced in primary-winding 1P is changed into the direct current voltage graduated by the capacitor 5, and is supplied to a load 9 as direct current power.
[0003]
[Problem(s) to be Solved by the Invention] By the way, when direct-current output voltage is switching power supply equipment which is about 3.3V, there is a problem that the rate that the forward voltage drop of the high-speed rectifier diode 4 occupies about 0.5V and to direct-current output voltage is high, and the power conversion effectiveness in which this is high owing to is not acquired. It is expected that the power metal-oxide semiconductor field effect transistor used for switching power supply equipment as a solid state switch 3 can reduce a forward voltage drop sharply when a switching loss replaces this with the high-speed rectifier diode 4 as power metal-oxide semiconductor field effect transistor for synchronous detection, since on resistance is also low few, and it can raise conversion efficiency on the other hand. However, since there is a property in which a current flows bidirectionally in power metal-oxide semiconductor field effect transistor, when the potential by the side of secondary-winding 1S becomes lower than the potential by the side of a load, a current flows backwards from a load side (capacitor side) to a transformer side, and since the load of a transformer increases with this back flow power, the problem that a transformer 1 is enlarged occurs.
[0004] Moreover, although the regenerative-control equipment of the flyback converter method which used bidirectionally the property in which a current flowed, positively is also known by power metal-oxide semiconductor field effect transistor Since there is a problem that it is nonavoidable that the load of a transformer increases and a transformer is enlarged by regeneration of power by this method owing to this, In the switching power supply equipment whose direct-current output voltage than to which greater importance is attached to the miniaturization by high-frequency-izing is about 3.3V The back flow of the current of power metal-oxide semiconductor field effect transistor is prevented, it uses as power metal-oxide semiconductor field effect transistor for synchronous detection, power conversion effectiveness is improved, and the ED of the direction which miniaturizes a transformer is called for.
[0005] The purpose of this invention is to prevent the conduction of the reverse current of the power metal-oxide semiconductor field effect transistor for synchronous detection, and mitigate the load of a transformer, and reduce a forward voltage drop.
[0006]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, according to this invention, it is the control unit of the power metal-oxide semiconductor field effect transistor for synchronous detection which is connected to the secondary-winding side of the pulse transformer of the switching power supply equipment which makes a basic circuit a flyback converter circuit, a forward converter circuit, etc., and rectifies the output current. Change of the direction of the current which flows with a gate driving signal between the source drains of said power metal-oxide semiconductor field effect transistor for synchronous detection which can control forward current and a reverse current is supervised. The detector of a current with which it has an antisuckback means to stop the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for period synchronous detection where a reverse current flows, and an antisuckback means flows in the circuit by the side of said secondary winding, and the resistor connected to the output side, When it judges that the direction of the current which consists of a comparator circuit which supervises change of the potential of the both ends of this resistor, and flows from change of the potential of the both ends of this resistor to the power metal-oxide semiconductor field effect transistor for synchronous detection changes from forward current to a reverse current, It shall form and become so that the driving signal which a comparator circuit supplies to the gate of the power metal-oxide semiconductor field effect transistor for synchronous detection may be stopped.

[0007]

[Function] In this invention, change of the direction of the current which flows to the power metal-oxide semiconductor field effect transistor for synchronous detection is supervised. By having constituted so that an antisuckback means to stop the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for period synchronous detection where a reverse current flows might be established The property of the power metal-oxide semiconductor field effect transistor which can control the current of the forward direction and hard flow by gate voltage, With combination with an antisuckback means to stop the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for period synchronous detection where change of the direction of this current is supervised, and a reverse current flows Since the conduction of the reverse current of the power metal-oxide semiconductor field effect transistor for synchronous detection can be prevented It becomes possible to operate power metal-oxide semiconductor field effect transistor as a low rectifying device of the on resistance which rectifies the output current synchronizing with the on-off control action of a solid state switch. Direct-current output voltage is 3.3. When it applies to the switching power supply equipment which is bolt extent, while the function which improves power conversion effectiveness using the low on resistance of power metal-oxide semiconductor field effect transistor is obtained The back flow of the power by the side of a transformer is prevented, the load of a transformer is mitigated, and the function which miniaturizes a pulse transformer is obtained.

[0008] Furthermore, the detector of a current which flows an antisuckback means to the secondary-winding side circuit of a pulse transformer which has the power metal-oxide semiconductor field effect transistor for synchronous detection and the resistor connected to the output side, When it judges that the direction of the current which consists of comparator circuits which supervise change of the potential of the both ends of this resistor, and flows from change of the potential of the both ends of this resistor to the power metal-oxide semiconductor field effect transistor for synchronous detection changes from forward current to a reverse current, If it constitutes so that the driving signal which a comparator circuit supplies to the gate of the power metal-oxide semiconductor field effect transistor for synchronous detection may be stopped, since a resistor is prepared in the output side of the current transformer as a current detector and loss can be reduced, although the number of configuration members increases, the function to attain the purpose of invention is obtained.

[0009]

[Example] Hereafter, this invention is explained based on an example. Drawing 1 is the connection diagram simplifying and showing the switching power supply equipment of a flyback converter method using the power metal-oxide semiconductor field effect transistor for synchronous detection which becomes the example of reference of this invention, and omits the duplicate explanation by giving the same reference mark to the same component as the conventional technique. In drawing, the power metal-oxide semiconductor field effect transistor 3 as DC power supply 2 and solid state switches, such as a rectification bridge, is connected to primary-winding 1P of a pulse transformer 1 as usual. Moreover, a drain side is connected to secondary-winding 1S for the source side of the power metal-oxide semiconductor field effect transistor 13 for synchronous detection which the power metal-oxide semiconductor field effect transistor 13 for synchronous detection and the capacitor 5 for smooth are connected to secondary-winding 1S of a pulse transformer 1 as a rectifying device of the output current, and chooses the polarity of the coil of a pulse transformer 1 as subtractive polarity like - mark of drawing, and has conduction nature in order reverse both directions at a load 9 side. Moreover, an antisuckback means to control the gate voltage of the power metal-oxide semiconductor

field effect transistor 13 for synchronous detection consists of a comparator circuit 14, and when source potential falls to less than [drain potential an EQC, or it], it is constituted so that the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for synchronous detection may be stopped.

[0010] In the flyback converter form switching power supply equipment constituted as mentioned above, when a solid state switch 3 turns on, electromotive force occurs in the direction which turns the power metal-oxide semiconductor field effect transistor 13 for synchronous detection to the secondary coil side of a transformer 1 from the drain side at a source side, and passes a reverse current. However, at this time, since the potential of the power-metal-oxide-semiconductor-field-effect-transistor both ends for synchronous detection becomes low by the source side highly by the drain side, the comparator circuit 14 which supervises this suspends the output of that output gate voltage. For this reason, the power metal-oxide semiconductor field effect transistor 13 which can control the current of order reverse both directions will be in an OFF state with gate voltage, the increment in the load of the pulse transformer 1 conventionally produced when the output current flowed backwards to a secondary coil is prevented, and while becoming possible to miniaturize a transformer 1, supply of the direct current power to a load 9 is performed by emitting the stored charge of a smoothing capacitor 5.

[0011] Moreover, when a solid state switch 3 turns off, back EMF produced in primary-winding 1P is transmitted to the secondary-winding 1S side, the both-ends potential of the power metal-oxide semiconductor field effect transistor 13 for synchronous detection is high by this at a source side, and since it becomes low by the drain side, the direct current power which the comparator circuit 14 which has sensed this outputted the gate voltage to which the conduction of forward current is urged, was rectified by the power metal-oxide semiconductor field effect transistor 13 for synchronous detection, and was graduated by the capacitor 5 is supplied to a load 9. Consequently, on resistance is enabled to use the property of low and low loss power metal-oxide semiconductor field effect transistor compared with rectifying devices, such as a Schottky barrier diode, and the advantage which can improve the power conversion effectiveness of switching power supply equipment is acquired.

[0012] Drawing 2 is the connection diagram showing the modification of the above-mentioned example of reference, the power metal-oxide semiconductor field effect transistor 13 for synchronous detection is moved to the other-end child side of secondary-winding 1S, and although it differs from the above-mentioned example of reference in that the source side was connected to the coil, even if constituted in this way, the same operation effectiveness as the above-mentioned example of reference can be acquired. Moreover, although not illustrated, when it connects with the secondary winding of a pulse transformer by making into forward current the current which faces the power metal-oxide semiconductor field effect transistor 13 for synchronous detection to the source from the drain, it also sets. So that the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for synchronous detection when source potential falls to less than [drain potential, an EQC, or it] may be stopped By connecting a comparator circuit 14 to the power metal-oxide semiconductor field effect transistor 13 for synchronous detection, the same operation effectiveness is acquired also in the above-mentioned example of reference.

[0013] The connection diagram which drawing 3 simplifies the flyback converter form switching power supply equipment using the control device of the power metal-oxide semiconductor field effect transistor for synchronous detection which becomes the example of reference from which this invention differs, and is shown, The resistor 25 by which drawing 4 is the connection diagram simplifying and showing the modification of a different example of reference shown in drawing 3 , and series connection was carried out to the secondary-winding side circuit of a pulse transformer which has the power metal-oxide semiconductor field effect transistor 13 for synchronous detection in the antisuckback means 21, The point constituted from a comparator circuit 24 which supervises change of the potential of the both ends of this resistor differs from the above-mentioned example. The same operation effectiveness as the above-mentioned example of reference is acquired by transposing the source potential and drain potential of the power metal-oxide semiconductor field effect transistor 13 for synchronous detection to the potential of the both ends of a resistor 25, and detecting them. In addition, you may connect with the location shown in drawing 4 , and a resistor 25 can choose the connecting location as arbitration.

[0014] Drawing 5 is the connection diagram simplifying and showing the flyback converter form switching power supply equipment using the control device of the power metal-oxide semiconductor field effect transistor for synchronous detection which becomes the example of this invention. The detector 33 of a current which flows the antisuckback means 31 to the secondary-winding side circuit of a pulse transformer 1 which has the power metal-oxide semiconductor field effect transistor 13 for synchronous detection, and the resistor 35 connected to the output side, It constitutes from a comparator circuit 34 which supervises change of the potential of the both ends of this resistor. When it judges that the direction of the current which flows from change of the potential of the both ends of a resistor 35 to the power metal-oxide semiconductor field effect transistor 13 for synchronous detection changes to a reverse current from

forward current, It is constituted so that the driving signal which a comparator circuit 34 supplies to the gate of the power metal-oxide semiconductor field effect transistor 13 for synchronous detection may be stopped. Since the loss can be reduced by preparing a resistor in the output side of the current transformer as a current detector 33, although the number of configuration members increases, the same operation effectiveness as each above-mentioned example of reference is acquired.

[0015] Drawing 6 is the connection diagram simplifying and showing the switching power supply equipment of a forward converter method using the control device of the power metal-oxide semiconductor field effect transistor for synchronous detection which becomes the example of reference of this invention, a pulse transformer 11 is equipped with the tertiary winding for DC-magnetic-deviation prevention which is not illustrated, and that polarity of primary-winding 11P and secondary-winding 11S is connected so that it may become additive polarity, as - mark shows to drawing. Moreover, the power metal-oxide semiconductor field effect transistor 13 for synchronous detection, the capacitor 5 for smooth, a reactor 7, and the reflux diode 6 are connected to the secondary-winding 1S side as a rectifying device of the output current, and a drain side is connected to secondary-winding 11S for a source side through a reactor 7 at a load 9 side by making into forward current the current which goes to a drain from the source. Moreover, an antisuckback means to control the gate voltage of the power metal-oxide semiconductor field effect transistor 13 for synchronous detection is having explained drawing 1 from a comparator circuit 14 similarly, and when it falls to less than [it], it is constituted so that source potential's being equivalent to drain potential or the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for synchronous detection may be stopped.

[0016] Thus, it sets to the switching power supply equipment of the constituted forward converter method. When forward current flows to the power metal-oxide semiconductor field effect transistor 13 for synchronous detection when a solid state switch 3 turns on, and a solid state switch 3 turns off, Since the comparator circuit 14 which detected this by the source potential of the power metal-oxide semiconductor field effect transistor 13 for synchronous detection becoming low compared with drain potential suspends the output of the driver voltage to the gate While power metal-oxide semiconductor field effect transistor functions as power metal-oxide semiconductor field effect transistor for synchronous detection, prevents the back flow power by the side of a transformer and mitigates the load of a transformer, the effectiveness of improving the power conversion effectiveness of switching power supply equipment using the low on resistance of power metal-oxide semiconductor field effect transistor is acquired.

[0017]

[Effect of the Invention] This invention supervised change of the direction of the current which flows to the power metal-oxide semiconductor field effect transistor for synchronous detection as mentioned above, and it constituted it so that an antisuckback means to stop the driving signal supplied to the gate of the power metal-oxide semiconductor field effect transistor for period synchronous detection where a reverse current flows might be established. Consequently, it becomes possible to use power metal-oxide semiconductor field effect transistor as a low rectifying device of the on resistance which rectifies the output current synchronizing with the on-off control action of a solid state switch, and direct-current output voltage is 3.3. When it applies to the switching power supply equipment which is bolt extent, while the function which improves power conversion effectiveness using the low on resistance of power metal-oxide semiconductor field effect transistor is obtained, the back flow of the power by the side of a transformer is prevented, the load of a transformer is mitigated, and the advantage which can miniaturize a pulse transformer is acquired.

[Translation done.]

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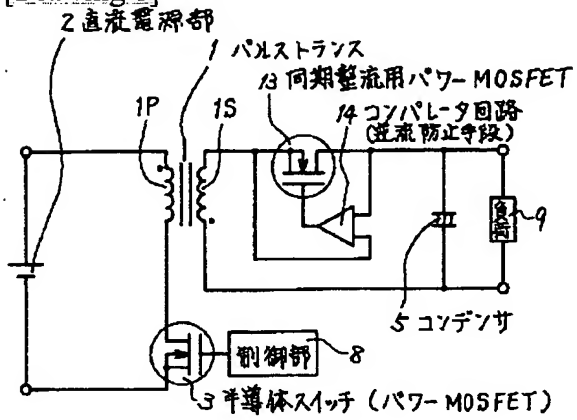
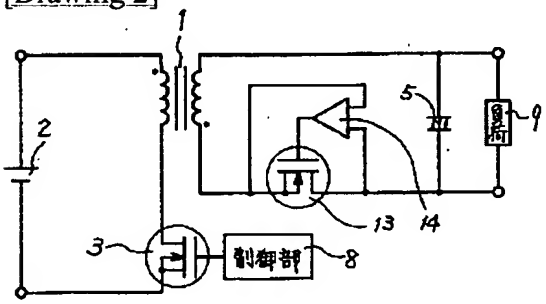
DRAWINGS

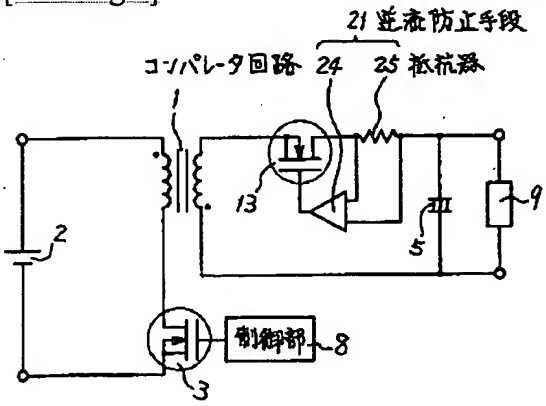
[Drawing 1]



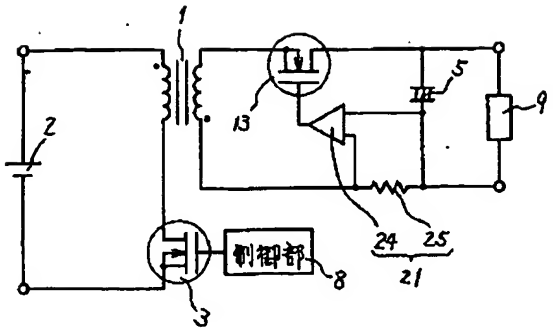
[Drawing 2]



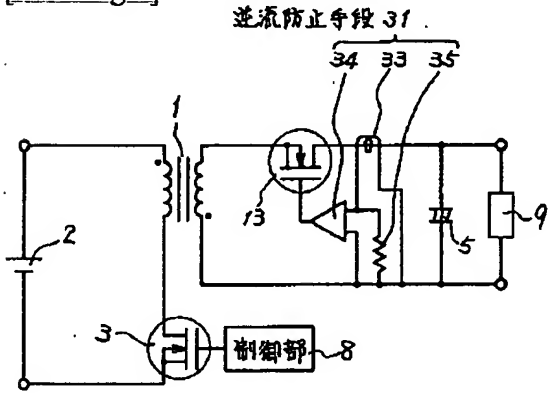
[Drawing 3]



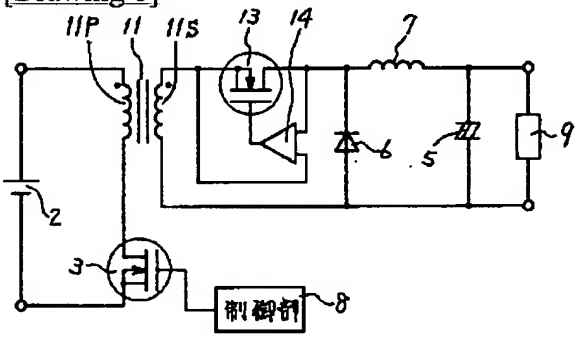
[Drawing 4]



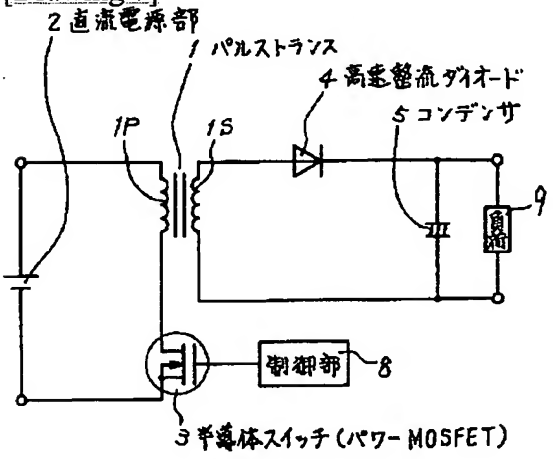
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]